

DEVICE FOR IMAGE PROJECTION**BACKGROUND OF THE INVENTION****a) Field of the Invention**

The invention relates to an arrangement for displaying images on a projection screen, which arrangement includes a laser, which emits a laser beam, and a deflecting means, which is provided for deflecting the laser beam, and an image-generating means which is connected to a controlling device for controlling the laser and the deflecting means.

b) Description of the Related Art

Image-generating means are increasingly used for light effects in show business for entertainment and information, not only within enclosed spaces, but also in the open. In addition, a laser television apparatus, in which lasers are also used to generate images, is being developed.

In these fields of application, in which the effective radiation of the lasers is within the visible region of the spectrum and in which several watts of medium power is required, the spatial region to which the laser has access is detrimental to the health of human beings. This is particularly true in the case of vertical projection, where persons may be located between the image-generating means and a projection screen. Persons are at risk if they happen to come into the immediate range accessible to the projecting laser. It is possible for this risk to be extremely high when the laser used for the projection is directed immediately at a person, owing to interference with the projector, e.g. when the deflecting means stalls.

Yet safety risks cannot be ruled out even in the case of back projections, during which the viewers are generally separated from the laser apparatus by means of a projection screen, even if the entire laser projection system were to be located in a closed housing. For example, a service technician is required to open the housing and to observe the image, in order to adjust it. In so doing, it is possible that parts of his body may fall within the range accessible to the laser.

For lasers used in shows in which the public may happen to enter into that area which is swept by the laser, standards for precautionary means are being prepared in a number of countries. In this regard, the proposed standards are, however, no more than simple contrivances, such as providing a key-operated switch for opening a housing, or an emergency switch. In addition, there are regulations to the effect that lasers shows are to be controlled such that no laser beam will unintentionally fall into the auditorium. The risks to which the public is exposed remain very high, even if these regulations are adhered to, such that it is desirable to provide for increased safety in respect of the arrangement as set out above.

Safety devices are, however, known from other technical fields. Thus, U.S. Pat. No. 5 221 977 proposes, by using spectrum-selective means, to screen off only certain wave lengths and, instead, use holographic elements. The disadvantage in this regard is that information is filtered out at these wavelengths which, in an image-generating means of the type mentioned, is actually intended to reach the eye of the viewer.

Other safety devices include means for switching off the laser, or for reducing the light output power, when no defined reflection is noted in that region into which the laser is directed. Safety devices of this kind are described, for example in DE 33 40 427 A1 and in WO 94 28 972. In particular, the latter printed document describes a device in

which a laser is designed to be switched on only when that part of the body, which is to be exposed to the laser for medical purposes, screens the laser from the other parts of the body. Thus, the laser is switched on only when, for example, a finger to be exposed covers an outlet opening for the laser burst.

It is not possible to use safety systems of this kind in arrangements for image generation according to the state of the art as set out above, since here the laser beams must remain visible to the spectators. As stated above, experts on standardization committees make no mention of any means whereby it would be possible to prevent persons from accidentally entering into the hazardous area swept by the laser.

OBJECT AND SUMMARY OF THE INVENTION

The primary object underlying the invention is to provide an arrangement of the kind mentioned at the outset, which meets high requirements regarding the protection of persons in the danger area of a projection laser beam used for image generating.

On the basis of the generic prior art, this object is met in that the image-generating means is switchable in two operating modes, the first operating mode being the standard operating mode for projecting, and the second being an operating mode in which the laser radiation is harmless to a person disposed in the area to which the laser has access, and in that a safety circuit is provided and comprises at least one sensor, by means of which a monitored area, which is larger than the area accessible to the laser, between the image-generating means and the projection screen is monitored as to the presence of objects, wherein the image-generating means is switchable into the second operating mode by means of the safety circuit, in the event of an object being present.

As a result of this feature, it is now possible to provide a very high safety standard for television projection systems using lasers. In this regard, however, a method is used which is precisely the opposite of that used in the above-described medical lasers. In said medical lasers, the apparatus was operated in a danger-free manner when no object was detected, for example by a sensor. In contrast, the sensor according to the invention serves to switch the laser into a safe operating mode when a person is disposed in the monitored area. In so doing, the invention differs substantially from the state of the art.

In the simplest case, it is possible for the switchover into the above-mentioned second operating mode, in which the laser does not pose a danger to persons, to be a switching-off of the projection laser. Since the deflecting means is also controllable via the image-generating means, it is, however, possible for the laser to be blanked in the second operating mode only when it is guided by the deflecting means into that area in which the person to be protected is located. This feature makes it possible, for example for servicing work, for the image to be observed during possible adjusting operations, despite the apparatus being open, and this image is blanked only in regions in which a body part enters the area which is accessible to the laser. In so doing, the service technician will perceive the body part as being a shadow in the image, thereby being warned to proceed with greater care.

According to the invention, it is ensured that any object, say a person, located in the monitored space between the image-generating means and the projection screen, or entering into said space, is automatically perceived by the